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MR effect enhancement of bidisperse MR fluids containing micron- and nano-sized iron particles

MASAMI NAKANO, Institute of Fluid Science, Tohoku University

Magnetorheological (MR) fluids are suspensions of micron-sized magnetic particles dispersed into carrier oils, and behave like a Bingham fluid having magnetic-field responsive yield stress. In this research, bidisperse MR suspensions containing micron- (6.6 mm) and nano- (110nm) sized spherical iron particles into silicone oil were fabricated to enhance the MR effects. The steady and dynamic MR properties have been investigated in close relation to the magnetic-induced particle cluster structure and the visualized shear flow behaviors. The static and dynamic behaviors of the particle cluster structures formed in the MR fluids under applied magnetic fields were directly visualized using an optical microscope. And the steady and dynamic MR properties of the bidisperse MR fluids were measured using a magnetic field applicable parallel-disk rheometer. The MR effects of the bidisperse MR fluids changed significantly as a function of the solid fraction of nano-particles. Interestingly, field-induced shear stress was remarkably enhanced at higher shear rate when the solid fraction of nano-particles was around 25%. The enhancement of the shear stress can be attributed to the formation of distinct and wide particle cluster chains.